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Using Daily Problems to Measure Math Literacy and Characterise Mathematical Abilities for Students in South Sulawesi

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ABSTRACT

There are many reasons why math literacy is important for pupils in the school and daily problems are more realistic to understand what kind of mathematical abilities they have. This study aims to describe the use of daily problems as an indicator to measure mathematical literacy and to characterise mathematical abilities of students. Additionally, mathematics literacy is important to support mathematical abilities as the form of competence of learners in mathematics. Survey research was conducted to 159 junior high school students in South Sulawesi. This research applied mathematical literacy test to find data of students' literacy. The results showed that the tendency of the percentage of students to be able to give a reason but it is not accurate to not give a reason at all starting from 32.08% to 96.86%. This figure represents the students' ability to argue using their mathematical knowledge is still below 50%. In other words, most of the capabilities of mathematical knowledge of students is not well developed due to the mathematical literacy of students is not developed.

Keyword: Daily Problems, Math Literacy, Mathematical Abilities.

1. Introduction

Literacy is often associated with letters (characters) or linguistically interpreted as "literate". Literacy has been a warm conversation among international and became the hope of the world. Various parties heavily literacy assessment and find ways to improve literacy in many countries. They have realized that the world to face the younger generation getting older necessary perceptive and critical. However, Indonesia in the international level is seen has not been able to give birth to a literated generation. According to data from the Programme for International Student Assessment (PISA) 2000, 2003, 2006, 2009 and 2012, Indonesian students' mathematical literacy is still low. In 2012, Indonesia was ranked 64 out of 65 countries, with a score of 375, while international score is 494 [3].

For elementary level, there are seven of standard of competencies that students should be engaged with. From those, every single item were addressed to

how they can apply for their daily life [6]. Compared with revised curriculum (K-13), the target of knowledge domain is facilitating students having factual and conceptual knowledge based on their curiosity about science, technology, art, and culture within humanity perception, nationality, citizenship, and civilization in related with phenomena and events in the environment, school, and play park. Meaning that the important knowledge they have after learning is addressed to tackle any kind of problems students face in daily activities. However, this is not in line with the data above which is Indonesian students below the level of PISA standard. It means that there is such students' activities incompatible with program to support math literacy or any program to deconstruct students' literacy. Because of this, [5] argued that the instrument of learning assessment designed by teachers of Junior Secondary School in Indonesia generally presented lack of literacy development.

PISA mathematical literacy within the framework of Mathematics in 2012 defined as an individual's ability to formulate, use and interpret mathematics in various contexts. Including the ability to perform reasoning mathematically and using the concepts, procedures, facts, as a tool for describe, explain and predict a phenomenon or event. Mathematical literacy can help individuals to recognize the role of mathematics in the real world and as a basis for consideration and determination of decisions needed by society [2]. Being matematically literate, competencies needed that form the heart math literacy [4], for example PISA.

Harnessing more useful help of PISA problems, students can be triggered to exhibit their mathematical ability. [1] supposed that every student has the ability to study mathematics, even though some students explore and create connections faster than others. All of students have some mathematical ability, but some of them have potential far beyond what dominant people are provided to trust. Furthermore, Borovik & Gardner emphasise indicators of mathematical abilites including ability to make and use generalisations, rapid and sound memorisation of mathematical material, ability to concentrate on mathematics for long periods, ability to offer and use multiple representations of the same mathematical object, an instinctive tendency to approach a problem in different ways, ability to utilise analogies and make connections, preparedness to link two (or more) elementary procedures to construct a solution, ability to recognise what it means to "know for certain", ability to detect unstated assumptions in a problem, and either to explicate and utilise them, or to reject the problem as ill-defined; a distinctive tendency for "economy of thought," striving to find the most economical ways to solve problems, for clarity and simplicity in a solution; instinctive awareness of the presence and importance of an underlying structure; lack of fear of "being lost" and having to struggle to find one's way through the problem, a tendency to rapid abbreviation, compression or a curtailment of reasoning in problem solving; an easy grasp of encapsulation and de-encapsulation of mathematical objects and procedures.

Mathematical literacy involves seven basic skills that should be possessed [2], namely: (1) Communication, ability to communicate problems; (2) mathematizing, the ability to change the problems of the real world into the form of mathematics or vice versa; (3) Representation, the ability to restate a mathematical problem; (4) Reasoning and Argument, the ability to reason and reason; (5) Devising Strategies for Solving Problems, the ability to use problem solving strategies; (6) Using Symbolic, Formal and Technical Language and Operation, capability uses symbolic language, formal language and technical language; (7) Using Mathematics Tools, the ability to use mathematical tools, for example in the measurement.

Combining those two theories, this study only emphasize what is the number of students who have good understanding as well as powerful reason in their constructed answer. Following this, what kind of abilities are in which students are lack of mathematical knowledge.

Based on this, it is interesting to bring mathematics problems, in particularly daily problems, as challenging topic to measure mathematical literacy. Learning from problems literacy on PISA and TIMSS (Trends International Mathematics and Science Study) which requires reasoning and problem solving skill share experience to develop local context as the main idea of the problems. Subsequently, daily problems in this case refers to what students have understanding on it. Meaning that there is no strange context used to explore their such literacy or the things that students have no idea related with.

Taking advantage in classroom experience, it was undoubtful that many of secondary graders can show their works to calculate and compute as mathematical process in solving the problems. Even word problems created by their teachers are not getting difficult for children to solve it using their arithmetic understanding. However, the solution include the correct procedure it becomes questionable. The challenge is interconnection between the problem and its solution. If the readers try to understand step by step of arithmetic procedure, for example, they will find no problem on it. The thing is when connecting the main idea of problem with the solution since students only consider about the numbers, separated with the main problem. We called this obstacle is low interpretation. Lastly, how to communicate by showing arguments or reasons to accompany their answer is not easy to find students' work excellently, especially for South Sulawesi students.

Starting from this problem, this study has endeavor to share information how good is South Sulawesi students to develop their mathematical literacy in solving mathematical daily problems and what kind of mathematical ability they exhibit in their performance.

2. Methodology

Survey research was type of exploration to support this study conducted to 159 junior high school students in South Sulawesi. This research applied mathematical literacy test to find data of students' literacy. Then, the rubric of literacy assessment was provided for checking students' answer to measure their literacy. It was also accompanied by indicators checking of mathematical abilties.

In general, the survey carried out in several stages, namely: 1) Determine the research problem which are math literacy and mathematical abilities; 2) Making survey design, this application refers to measure math literacy by giving test all of respondents and the result would be identified what kind of mathematical abilities appear; 3) Develop a survey instrument, since there are two kinds of target of this study, the two instruments are including essay test and rubric as the guide to measure literacy and math abilites; 4) Determine the sample, this study was conducted in South Sulawesi; meaning that all of students who study in this area became main focus to explore the target; 5) Data processing and analysis; 6) Interpretation of the data; and 7) Making conclusions and recommendations.

In particularly, essay test was constructed here including 15 items. Its content are divided into three kinds of cognitive ability which are 7 items of analysis problems, 2 items of comprehension problems, and 6 items of application problems.

After collecting data, it was analyzed descriptively to determine the result of literacy math measure. Of course, quantitatively the data was analyzed using descriptive statistics, but in this case graph and diagram are used to describe the distribution of math literacy score. Meanwhile, the percentage is also exhibited to draw in terms of math literacy and mathematical abilities.

3. Result and Discussion

Of 15 items of math problems, there are 7 out of analysis items, while the rest of those are divided into 2 numbers of comprehension, and 6 numbers of application. These problems were developed using daily human activities. Started such daily problems, students are expected to explore their idea and trigger them to construct mathematical idea based on the situation. So, the test would be interesting and not exhaust thinking process in which students push themselves to recall mathematical formula or memorized knowledge.

Following this, there are 4 mathematical abilities which students will perform related with problems available. Firstly, ability to offer and use representation of mathematical object including reading or constructing graph, picture, table, or diagram. Then, abilty to utilise analogies and make connections, and preparedness to link two (or more) elementary procedures to construct a solution to a multi-step problem. Lastly, an instinctive tendency to approach a problem in different ways:

even if a problem has been already solved, a child is keen to find a alternative solution.

After trying out of competition, what we have it is shown in the following diagram. In order to understand what kind of information that this diagram is going to share us, mathematical literacy can help individuals to recognize the role of mathematics in the real world. Meaning that individual's ability to formulate, use and interpret mathematics in various contexts are abilities to perform reasoning mathematically and using the concepts, procedures, facts, as a tool for describe, explain and predict a phenomenon or event. So, the main point what this study want to explore how good is South Sulawesi students to develop their mathematical literacy in solving mathematical daily problems.

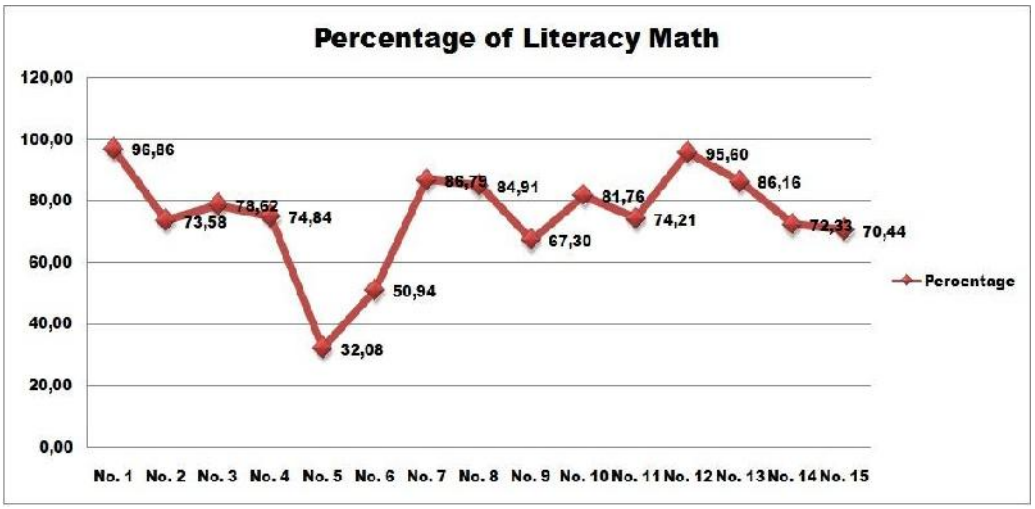

Figure 1. Percentage of Literacy Math Score

This figure shows that the score given to students' answer including mathematical concepts and explanation to connect between the formula and the context. Shortly, there are two considerations here. Firstly, students answer the question using mathematics formula correctly, and the last is promoting reasonable explanation to accompany the mathematics concept. This bring students to to recognize the role of mathematics in the real world and as a basis for consideration and determination of decisions needed by society [2].

The red line above describes the tendency of the percentage of students to be able to give a reason but it is not accurate to not give a reason at all starting from 32.08% to 96.86%. In detail, problem number 5 becomes the least of literacy percentage that means more than a half of students giving reasonable answer. The rest of items are quantified higher than 50%. This emphasize that students of secondary school in South Sulawesi need to be trained in their daily activities

constructing reasonable explanation, understanding the context, and making connection between the mathematical formula and the context of problem.

Table 1. Distribution of Mathematical Abilities Based on the Test Item

	Mathematical Abilities							
	Item Number	MA 1	Item Number	MA 2	Item Number	MA 3	Item Number	MA 2 & 4
Percentage	No. 1	3,14	No. 4	25,16	No. 12	4,40	No. 6	50,94
	No. 13	13,84	No. 5	67,92	No. 7	13,21		
	No. 8	15,09			No. 10	18,24		
	No. 3	21,38			No. 9	32,70		
	No. 11	25,79						
	No. 2	26,42						
	No. 14	27,67						
	No. 15	29,56						

Remark:
MA1 : ability to offer and use representation of mathematical object including reading or constructing graph, picture, table, or diagram
MA2 : abilty to utilise analogies and make connections
MA3 : preparedness to link two (or more) elementary procedures to construct a solution to a multi-step problem
MA4 : an instinctive tendency to approach a problem in different ways: even if a problem has been already solved, a child is keen to find a alternative solution.

The table 1 above explain that no more than a half of students have well-developed ability to share idea using mathematical object such as graph, picture, table, or diagram. As we know the object of mathematics should be understood as the package knowledge in order to construct and wrap their explanation mathematically. Using graph or diagram is one of skills that students can not show their work effectively. This also is followed by the ability of constructing link two (or more) elementary procedures to construct a solution to a multi-step problem. The highest percentage of this ability is 32,70% and holds only for item 9, whereas the rest is below 20%.

Although it cannot be generalized that students are not nicely done to show their analogies and make connection between context and mathematical knowledge, the no. 5 is little better than that no 4. Meaning that students are being more familiar with problem no. 5 than that problem 4. Considering the content of problems, MA1 is related with MA 2 in which students are low ability to solve problems considering representation mathematical object using table, chart, so on. So, this bring us to find the cause of the percentage of no 5 (67,92%) leading for the percentage of no. 4 (25,16%).

Unfortunately, only no. 6 which was constructed to explore combination between MA2 and MA4 (the abilty to utilise analogies and make connections and approach a problem in different ways to find a alternative solution) is produced as one of items. The percentage of this ability is more than 50%, and it is better than that both of MA1 and MA3. Based on the context, problem no. 6 is quite similar with problem no. 5 talking about solid figure. It means that students' knowledge are being developed if topics are related with solid figure construction, in particular cube.

Overall, the mathematical abilities of students to argue using their mathematical knowledge is still below 50%. In other words, most of the capabilities of mathematical knowledge of students is not well-developed due to the mathematical literacy of students is not developed.

4. Conclusion

Using 15 items of daily mathematical problems, this study shows that mathematical literacy of students in South Sulawesi is not well-developed in order to construct their answers. The fact that this study obtained is the percentage of students to be able to give a reason but it is not accurate to not give a reason at all starting from 32.08% to 96.86%. This emphasize that students of secondary school in South Sulawesi need to be trained in their daily activities constructing reasonable explanation, understanding the context, and making connection between the mathematical formula and the context of problem.

This study also explored four mathematical abilities which students will perform related with problems available. Firstly, ability to offer and use representation of mathematical object including reading or constructing graph, picture, table, or diagram. Then, abilty to utilise analogies and make connections, and preparedness to link two (or more) elementary procedures to construct a solution to a multi-step problem. Lastly, an instinctive tendency to approach a problem in different ways: even if a problem has been already solved, a child is keen to find a alternative solution. The result is the mathematical abilities of students to argue using their mathematical knowledge is still below 50%. In other words, most of the capabilities

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